the Energy to Lead

The Interrelationship of Natural Gas Supply, Technology and the Energy Market

> Ron Snedic,
GTI Vice President, Corporate Development

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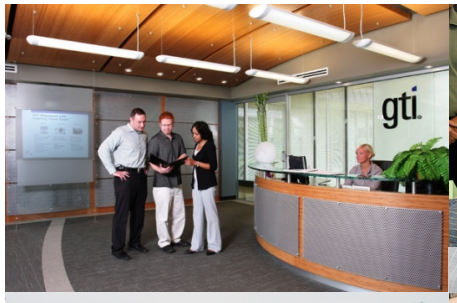
ESTABLISHED 1941

Company Overview

- Providing natural gas research, development and technology deployment services to industry and government clients
- Training future industry leaders
- Facilities
  - 18 acre campus near Chicago
  - 200,000 ft^2 with 28 labs
  - Offices in AL, CA, MA, PA, TX, Washington DC
- Staff of 250
- 350 active projects
- 1,200 patents; 500 products



Training

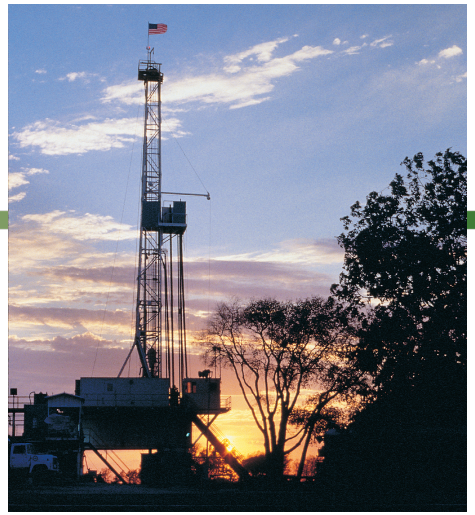
Office & Labs

Pilot-Scale Gasification Campus

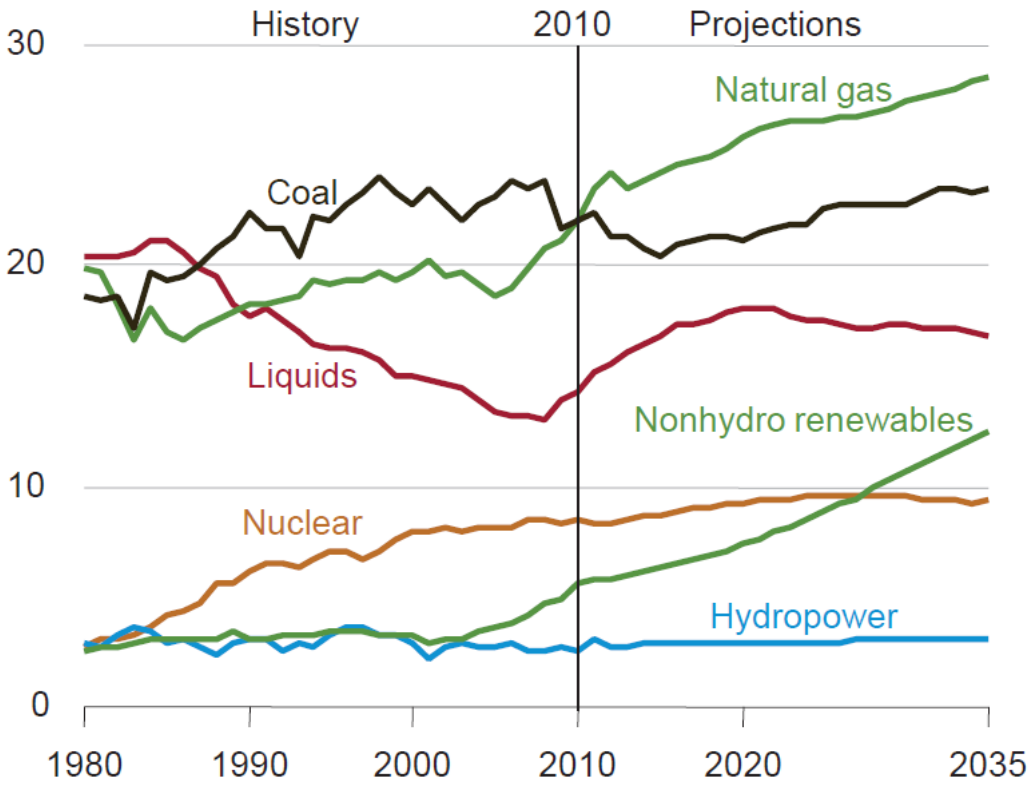
Energy & Environmental Technology Center

NATURAL GAS LEADERSHIP

U.S. Energy Production



Energy production by fuel, 1980-2035 (quadrillion Btu)



DOE-EIA AEO 2012

Natural Gas has become the leading energy source produced in the U.S.– quickly moving ahead of coal and nearly 50% greater than liquid fuel supplies. Natural gas is expected to expand this leadership role over the next two decades in the U.S.

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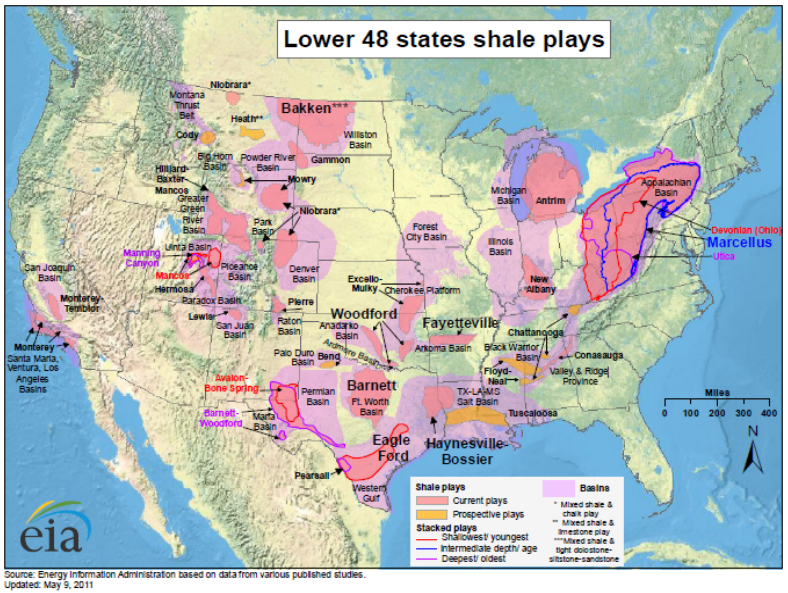
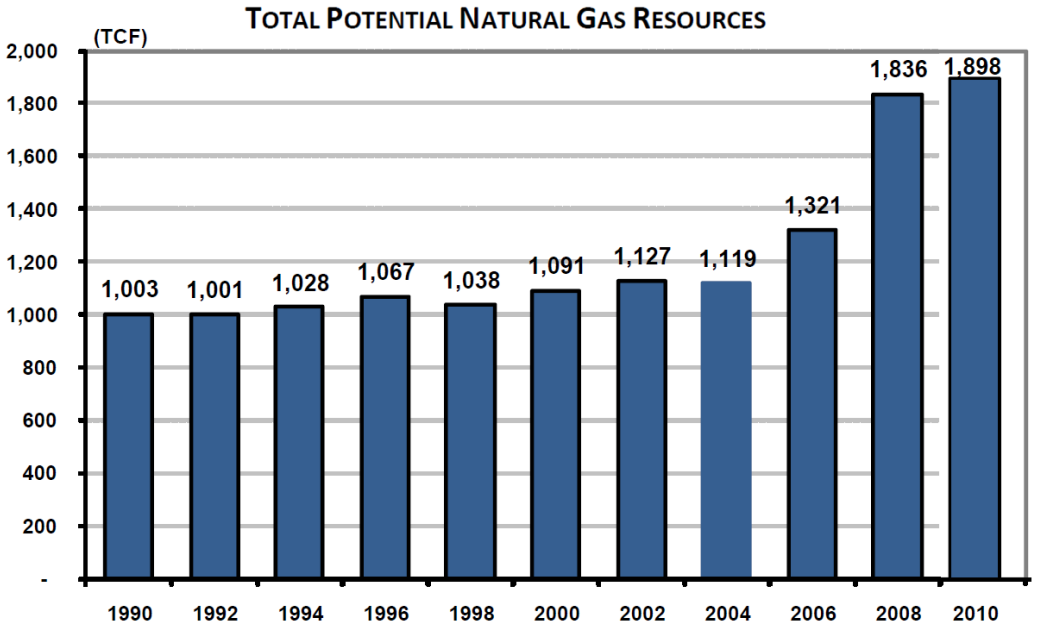
Natural Gas Supply Estimates

> The combination of shale gas and improved production techniques have **substantially** transformed the U.S. natural gas supply picture



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011



Source: Potential Gas Committee.

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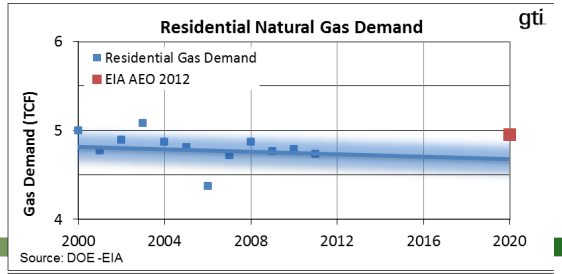
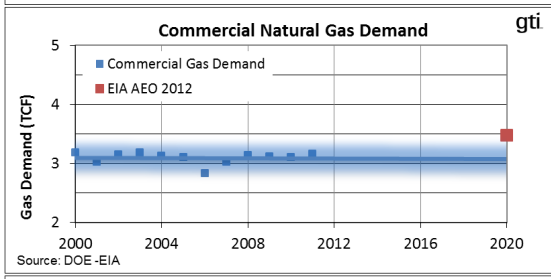
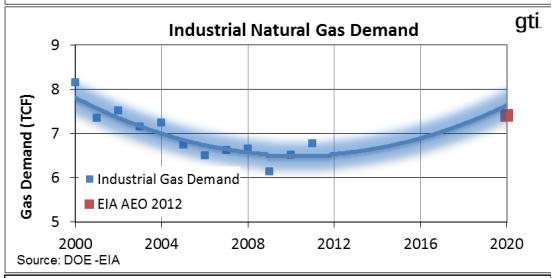
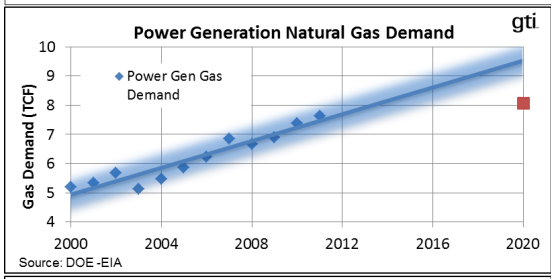
Natural Gas Demand Outlook

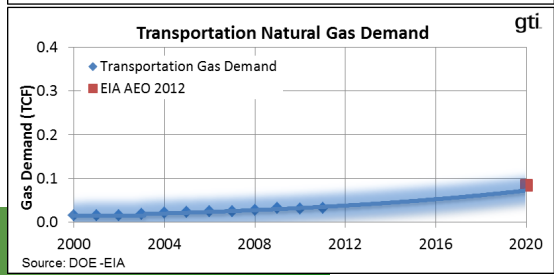
- Stable residential/commercial use
  - Smart, efficient use; source energy policies
- Industrial sector rebound
  - Onshoring; improved logistics and reduced shipping costs; chem/petrochem growth
- Growth led by power generation
  - Displace older coal power plants
  - **2020 potential may be understated**
- NGV interest growing sharply
  - Price differential to gasoline/diesel
  - **2020 potential may be understated**









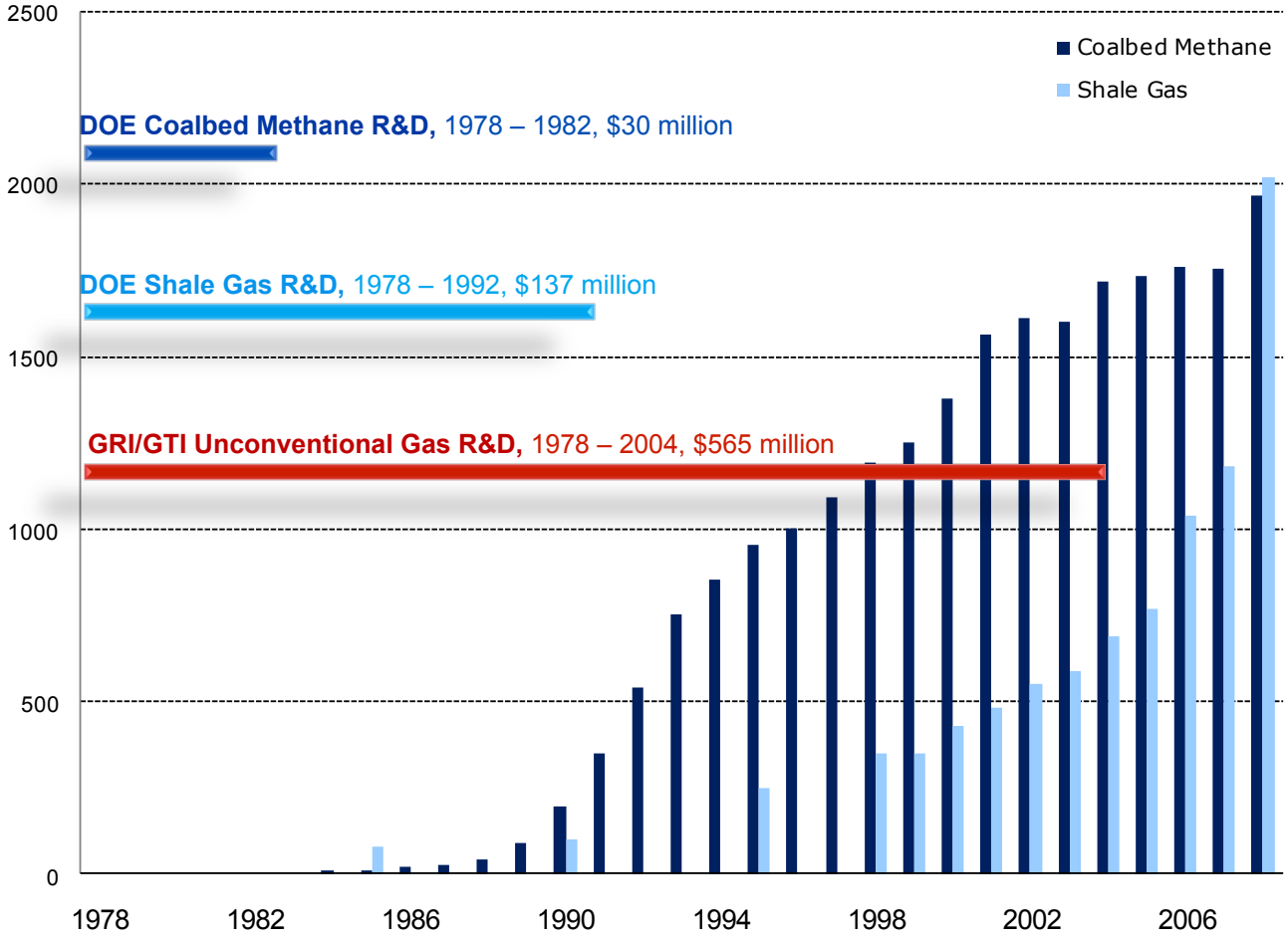


What's Technology's Role?

- Ensuring the continued availability of clean, low cost, domestic energy
- Enhancing safety, efficiency and reliability of our nation's energy infrastructure
- Minimizing environmental impacts across the energy supply, delivery and utilization spectrum
- Enabling renewables and sustainable energy

A PROMINENT FACTOR IN TODAY'S ABUNDANT SUPPLY

Looking Back: A Heavy Investment in Resource Development



DOE/GTI Led R&D Programs

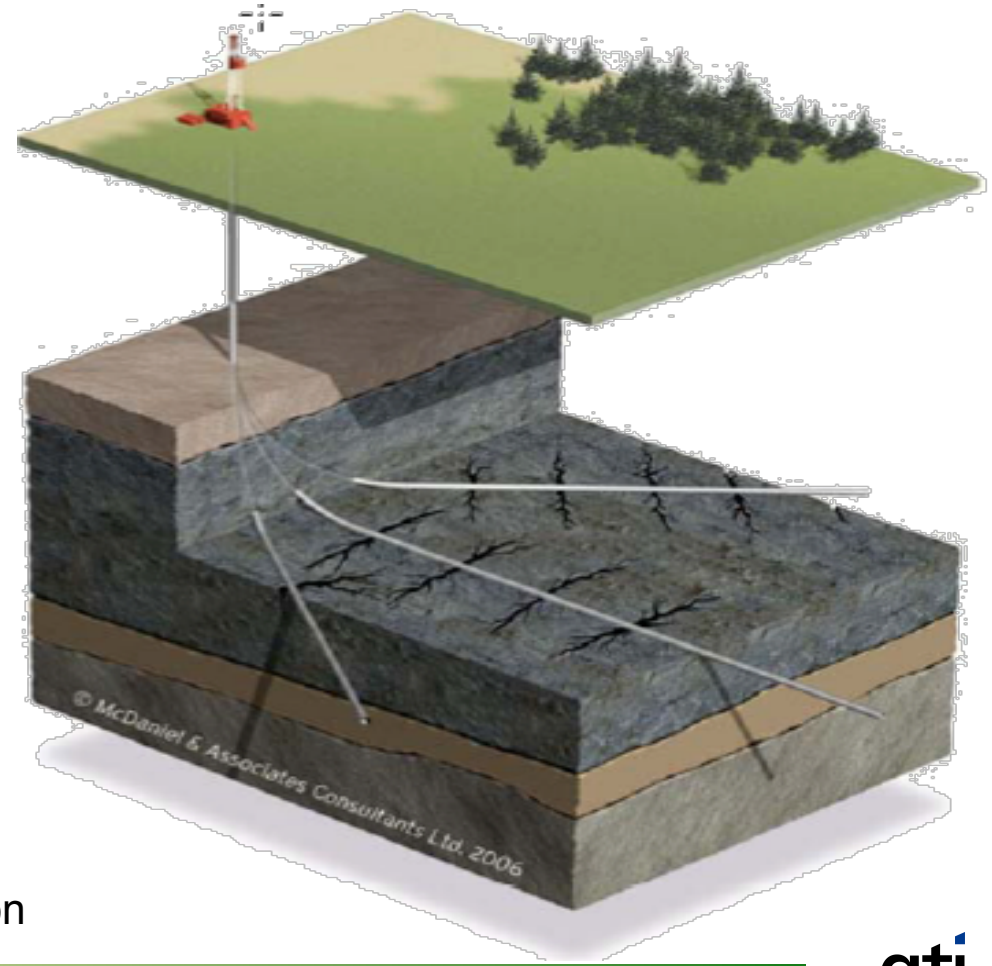
Shale expected to reach 50% of U.S. gas production by 2035

Sources: GTI, EIA, DOE Department of Fossil Energy

Key Technologies Unlocked Shale

> Horizontal wells
> Hydraulic fracturing
> Seismic imaging

George Mitchell,
Leader of the U.S. shale gas revolution



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PRODUCING CLEAN, LOW COST, DOMESTIC ENERGY

Advanced Hydraulic Fracturing

> Develop advanced methods and techniques for design and execution of environmentally safe and economically efficient hydraulic fracturing operations

Potential Impact of Project

> Reduce use of fresh water used for hydraulic fracturing

> Minimize truck traffic and corresponding air emissions

Participants

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BERKELEY LAB
Lawrence Berkeley National Laboratory

LSU
LOUISIANA STATE UNIVERSITY

OCTAVE
RESERVOIR TECHNOLOGIES

ATK

Berkeley
University of California

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SAFE, RELIABLE AND EFFICIENT INFRASTRUCTURE

Intelligent Utility Program

- Transition from paper based data collection to mobile, electronic data collection
- Utilize low cost technologies such as tablets and smart phones
- Decrease operational risk
  - Real time updates from the field
  - Increased data quality
  - Enable electronic tracking and traceability of all infrastructure components
- Increased efficiency

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Advancements in Natural Gas Vehicles and Infrastructure

Fuel Mule™ mobile fueling

ULTIMATE CNG, LLC
Clean Natural Gas

Navistar demo—12 Class 8 tractors for goods movement

CWI ISX 12G engine

3M News

Chesapeake ENERGY

FOR IMMEDIATE RELEASE

3M and Chesapeake Energy Corporation Partner to Create New CNG Tank Technology

Partnership signals growing strength of natural gas transportation fuel market

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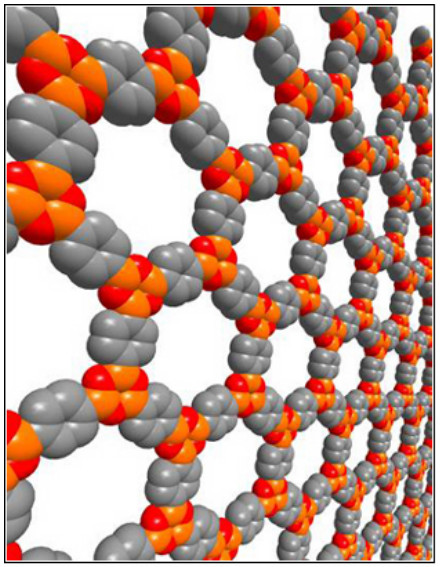
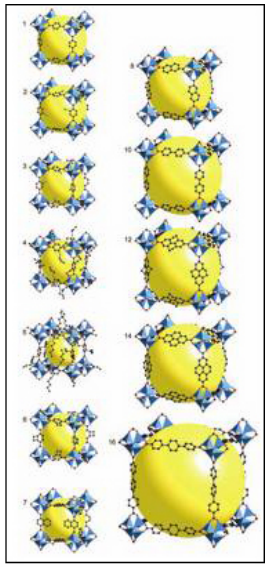
NGV Storage Materials and Home Fueling

Recent U.S. DOE ARPA-E Awards

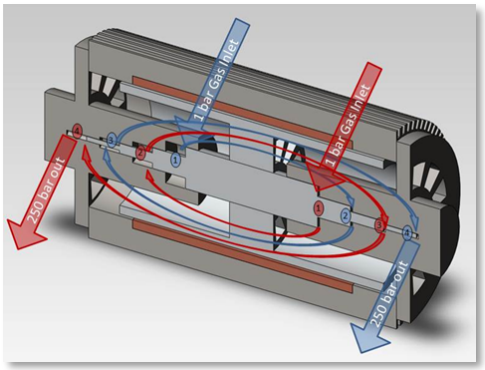
- Adsorbed natural gas system for light-duty vehicles using metal-organic framework (MOF) adsorbents
  - **Increased CNG storage at lower pressures**
- Single-piston, 4-stage linear motor compressor for home fueling
  - Prime: University of Texas
  - **Improved durability and efficiency**
  - **Decreased costs of overall system**



A Covalent Organic Framework



Metal-Organic Frameworks



EFFICIENT UTILIZATION OF DOMESTIC RESOURCES

Saving Money and Energy with New Technology

Ultramizer by
Cannon Boiler Works

Low-Oil-Volume Fryers by
Pitco Solstice & Frymaster

Combo Space-
Water Heating

Submerged
Combustion Melter

Micro CHP

High-Efficiency Rooftop
Gas PAC

Technology and Natural Gas are Transforming our Energy Future

- Abundant supplies
- Enhanced security
- Price stability
- Smaller carbon footprint
- New jobs
- Huge economic impact

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